Chapter 1
Introduction

This chapter introduces the Design for the Environment (DfE) Cleaner Technologies Substitutes Assessment (CTSA) for the lithographic printing industry. Section 1.1 contains background materials on the project, partners involved in the project, and the methodologies and assumptions used to create this CTSA. Section 1.2 discusses general aspects of the lithographic printing industry, such as what types of products are printed, how they are printed, and how the printing presses are washed. Section 1.3 discusses both traditional blanket washes and alternative blanket washes, and includes details on prices of the washes. Section 1.4 reviews the blanket wash market. Lists of blanket wash manufacturers and typical blanket wash components are presented. Section 1.5 describes the automatic blanket washing technology. The potential performance, cost, environmental impacts, and health and safety issues associated with using an automatic blanket washer are described.

Chapter Contents

1.1 Project Background
- 1.1.1 Design for the Environment Lithography Project
- 1.1.2 Document Overview
- 1.1.3 DfE Lithography Project Methodology

1.2 Overview of Lithographic Printing
- 1.2.1 Products Printed
- 1.2.2 Printing Mechanism
- 1.2.3 Types of Lithography
- 1.2.4 Blanket Washing

1.3 Profile of the Blanket Wash Use Cluster
- 1.3.1 Traditional Blanket Washes
- 1.3.2 Alternative Blanket Washes

1.4 Market Profile
- 1.4.1 Blanket Wash Market
- 1.4.2 Blanket Wash Manufacturers
- 1.4.3 Blanket Wash Components
- 1.4.4 Market Conditions

1.5 Alternative Technology - Automatic Blanket Washers

1.1 PROJECT BACKGROUND

1.1.1 Design for the Environment Lithography Project

The Design for the Environment (DfE) Lithography Project is a unique voluntary partnership between the lithographic printing industry and the U.S. Environmental Protection Agency (EPA) dedicated to helping printers improve their efforts to protect the environment. Because the printing industry is characterized by small companies that rarely have the time or resources to gather information on alternatives to their current products and processes, few printers have access to sufficient information to choose safer or lower risk chemicals, work practices, and technologies. The DfE Lithography Project aims to help fill this information gap. The goal of the project is to provide printers with pollution prevention and chemical risk information on product and technology substitutes, so that printers are better equipped to incorporate environmental concerns into their day-to-day business decisions. Specifically, the efforts of the DfE Lithography Project have focused on the risks, costs, and performance of alternatives to the traditional, highly volatile cleaners typically used for washing the press blankets.

What is Design for the Environment?

The Design for the Environment (DfE) Program harnesses EPA's expertise and leadership to facilitate information exchange and research on risk reduction and pollution prevention efforts. DfE works with businesses on a voluntary basis, and its wide-ranging projects include:

- Encouraging business to change their general business practices to incorporate environmental concerns into decision-making processes.
- Working with specific industries to evaluate the risks, performance, and costs of alternative chemicals, processes, and technologies.
- Helping individual businesses undertake environmental design efforts through the application of specific tools and methods.

DfE partners include:
Industry ■ Professional Institutions ■ Academia
Environmental Groups ■ Public Interest Groups ■ Other Government Agencies

1.1.2 Document Overview

Chapter 1 of the CTSA of Lithographic Blanket Washes provides background information on the DfE Lithography Project and the blanket wash industry. Chapter 2 describes the chemicals used in blanket washes and the human health and environmental hazards associated with these chemicals. Chapter 3 presents the environmental and occupational risks of the traditional and alternative blanket washes that were evaluated in the DfE Lithography Project. Chapter 4 describes the results of the performance demonstrations of the alternative blanket washes, a cost analysis for each product, and information on international trade issues. Chapter 5 looks at the energy and natural resource issues associated with each of the alternatives evaluated. Chapter 6 provides information on pollution prevention opportunities in blanket washing. Finally, Chapter 7 summarizes the evaluation of the trade-offs and presents a cost and benefits analysis.

This document is the result of a collaborative effort between EPA staff and printing industry representatives and experts. Each segment of this document was reviewed by the Technical Review Team (members are listed in the acknowledgment section) as it was developed. A complete draft, incorporating the earlier comments, was reviewed by the team and then the second round of comments were also incorporated prior to the printing of the final draft. Where significant disagreement among commentators occurred, the differing opinions are presented in the text.

What is a *Cleaner Technologies Substitutes Assessment*?

This technical document, referred to as a *Cleaner Technologies Substitutes Assessment* (CTSA), is intended to provide industry with the information needed to systematically compare the trade-offs associated with traditional and alternative products, processes, and technologies. Specifically, these trade-offs include the cost, performance, and environmental concerns such as risk, environmental releases, energy impacts, and resource conservation associated with a product or technology. This CTSA addresses blanket washes used in lithography and serves as the repository for all technical information developed by the DfE Lithography Project.

Project Considerations

The focus of this assessment was specifically defined by the project partners and has many limitations. Some of the global limitations are listed below, other limitations, specific to a particular portion of the project, are given in the applicable sections.

- This assessment focuses on the use of manual blanket washes in small lithographic printing facilities using only one press with four color units. Exposure estimates related to blanket wash use in larger facilities may be higher.
- The exposure and risk estimates reflect a small portion of the potential exposures within a lithographic printing facility. Many of the chemicals found in these formulations may also be present in the inks or other cleaning solvents used in a shop. Incremental reduction of exposures from blanket wash use will reduce cumulative exposures from all sources in a printing facility.
- The risks associated with volatile organic compound (VOC) releases were not examined in this assessment. Because VOC releases are a driving factor behind current regulations affecting printers, VOC content for the formulations are given at the request of industry participants. The concerns associated with VOC releases are addressed by federal, state, and local regulations and were not re-evaluated here.
- The regulatory information contained in the CTSA may be useful in moving away from chemicals that trigger compliance issues, however this document is not intended to provide compliance assistance. If the reader has questions regarding compliance concerns they should contact their federal, state, or local regulatory authorities.
- The 37 blanket wash formulations assessed in this report were voluntarily submitted by participating suppliers and are not intended to be representative of the entire blanket wash market.
- The performance and cost data are not based on rigorous scientific studies. Some of this information is subjective and is based on limited data points.
- Screening-level risk characterization techniques were used. The risk characterization results, therefore, contain limitations regarding confidence.

1.1.3 DfE Lithography Project Methodology

The DfE Program began working with the printing industry when the Printing Industries of America (PIA) requested the EPA's assistance in evaluating some of the environmental claims of products used by printers. This effort ultimately grew into three projects, each aimed at preventing pollution in a different sector of the printing industry: Screen Printing, Lithography, and Flexography. Each project addresses a specific area of environmental concern in the printing process. The screen printing project focuses on screen reclamation, the flexography project concentrates on the various ink systems used, and the lithography project examines the blanket washing process.

To thoroughly evaluate alternative blanket washes, the DfE Lithography Project sought to form partnerships with industry representatives. The DfE Lithography partners include PIA and its regional affiliates, the Graphic Arts Technical Foundation (GATF), the Environmental Conservation Board of the Graphic Communications Industry, the University of Tennessee's Center for Clean Products and Clean Technologies, and individual printers and suppliers.

How To Use This Document

For Printers:

- While this document does present all of the technical information collected on blanket washes through this project, it is not intended as a guidance document for a small business person to use to make decisions. For the small printer, more concise, user-friendly information products will be developed that present the specific information needed to help the printer in the decision-making process. These information products may include summary brochures, case studies, data matrices, guidance manuals, and training videos. After reviewing these more targeted information products, a printer may choose to return to the CTSA to obtain more technical details on a specific alternative that is of interest to their printing operation.
- The methods used to evaluate the blanket washes in this project, particularly the performance methodology, may also be of interest to printers. Although the CTSA focuses on blanket washes, printers can use the methodologies described in this document to conduct their own evaluations of other alternative products or processes.

For Suppliers:

- Suppliers may be interested in using the comparative risk, performance, and cost analyses presented in this document as a tool in identifying which blanket wash formulations are best suited for the current market where printers' environmental concerns are continually increasing.
- The environmental and human health data on the chemicals used in blanket wash formulations may be useful input to suppliers who are developing new blanket washes specifically designed to reduce environmental and human health risks.
- Suppliers may be interested in all of the methodologies used to evaluate the alternative blanket washes, particularly the risk methodology.

For Other Readers:

- For technical assistance programs, the CTSA can provide background information on lithography, blanket washes, and the DfE Lithography Project.
- The comparative information on cost, risk, and performance of alternative blanket washes can be useful when working with printers to reduce VOC emissions and hazardous wastes and guide printers toward products that might reduce risks or pollution.

Focus on Blanket Washes

The decision to focus on blanket washes was made by the DfE Lithography Project partners based on the input from printers. To make sound purchasing choices, printers expressed a need for more consistent information on the performance, costs, and environmental and human health risks associated with different blanket washes. To address these concerns, the project partners decided that a complete evaluation of commercially available blanket washes was needed. All blanket washes submitted were evaluated using the same criteria. This consistency allows printers to compare the trade-offs of one alternative with another to determine which products may be best suited for their particular printing operation.

For the first time, printers can access performance, risk, and cost analyses of a variety of alternative blanket washes, all evaluated using the same methodology.

The project partners were particularly concerned about the environmental and human health risks of blanket washes because traditionally these products are petroleum-based solvents with a volatile organic compound (VOC) content of greater than 60%. While these high VOC washes leave the blanket dry after cleaning, the quick-drying properties come from the VOCs that evaporate into the air where they may pose a potential risk to workers' health and to the environment. VOCs can have an adverse impact on ambient air quality because of their contribution to the formation of ground level ozone. Using the expertise of EPA, the DfE Lithography Project examined the risks of the alternative blanket washes by collecting health hazard and environmental release information (e.g., releases to air, water, land) associated with the use of the potential substitute blanket washes.

Concentrate on the Needs of Smaller Printers

The project partners were aware that although many large printers already have access to information about new and developing systems and technologies, smaller printers may not have the time or resources to investigate the latest technology and products. To respond to the needs of smaller printers, the DfE Lithography Project partners agreed that the primary efforts of the project should focus on the manual blanket washes as they are typically used in smaller print shops; i.e., on sheetfed, non-heatset presses that are less than 26" wide. Much of the information presented here is applicable or translatable to larger facilities.

Identify Alternative Blanket Washes

All blanket washes evaluated in this project were commercially available products, voluntarily donated by suppliers. Nineteen suppliers participated in the project, submitting a total of 36 substitute formulations to be compared with a baseline formulation.

Choice of VM&P Naphtha as the Baseline Formulation

In the initial stages of the Lithography Project, the Project partners chose VM&P naphtha as the baseline against which to compare the 36 substitute washes. Varnish Makers & Painters (VM&P) Naphtha, composed of 100% solvent naphtha, light aliphatic and referred to as Formulation 28 in certain sections of the text, was chosen primarily because it is well known among lithographers as an effective blanket wash. Many lithographers have used VM&P naphtha in their shops and know how well it works in their applications and what it costs. VM&P naphtha is known to be highly effective at very low cost, however, because of its high VOC content (100%), printers are searching for formulations to replace it.

Conduct Performance Demonstrations

The performance demonstrations were conducted in two phases: laboratory testing and field demonstrations. Laboratory testing of each blanket wash was conducted by GATF in Pittsburgh to ascertain certain chemical characteristics, including flash point, VOC content, and pH. Additional laboratory tests (described in Chapter 4 of this document) were conducted to determine the effectiveness of each wash and the potential for adverse effects on the blanket. Only those washes meeting minimum performance standards were used in the field demonstrations.

Once the Performance Demonstration was underway, certain suppliers who originally submitted blanket washes, later chose to withdraw from the demonstration. Their reasons included not wishing to reveal to EPA their complete formulations or concern over the potential results of the performance tests. The formulations that were withdrawn after work had already begun were numbers 2, 13, and 15. For this reason, those numbers are missing from all of the tables in the CTSA.

While the laboratory test was being conducted, DfE project partners identified lithographic printers who would volunteer their time and their shops to test blanket washes. In order to best demonstrate the performance of all the blanket washes under actual printing conditions, printers and project partners requested that field demonstrations be conducted. Seventeen printers agreed to participate in the performance demonstrations conducted between November of 1994 and February of 1995. Each substitute wash was assigned to a facility. Then, to get baseline information, every participating facility first cleaned the press with the baseline wash. Then the substitute wash was used for one week. During the week, press operators were asked to record the amount of product used, the length of time needed to clean the press, and their opinion of how well the product worked each time they used it, as compared to the baseline blanket wash, VM&P Naphtha.

To respond to the needs of smaller printers, the DfE Lithography Project partners agreed that the primary efforts of the project should focus on the manual blanket washes as they are typically used in smaller print shops: on sheetfed, non-heatset presses that are less than 26" wide.

Analyze the Costs of Using Alternative Blanket Washes

After the performance demonstrations, a cost analysis for each alternative product was developed using supplier data, industry statistics, and information collected during the performance demonstration. For each product, the cost of using the alternative product was compared to the cost of using the baseline product. Blanket washing costs were estimated based on the costs of labor, the blanket wash product, and cloth wipes. Each of these cost factors included:

Labor Costs: The time spent to clean the blanket was recorded for each product during the performance demonstrations. Labor costs were calculated by multiplying the time to clean the blanket by industry reported statistics for lithographic press operators' wages, including fringe rate, and overhead.

Blanket Wash Product Costs: The quantity of blanket wash used per blanket cleaning was recorded during the performance demonstration. To calculate the blanket wash product cost, the average quantity used per blanket was multiplied by the unit cost of each product. Product costs were provided by each participating manufacturer.

Cloth Wipes Costs: The wipes used for blanket washing are typically cloth wipes that are leased through a contract with an industrial laundry, which picks up dirty wipes for laundering and drops off clean wipes for blanket cleaning. Materials costs were calculated by multiplying the number of wipes used per blanket washing, as recorded in the performance demonstrations, by the lease price per wipe.

Evaluate the Health and Environmental Risks

Technical evaluation of the human health and environmental concerns associated with each blanket wash began while the demonstrations were still in progress. Suppliers submitted chemical formulation information to PIA for each of their products demonstrated. PIA removed all trade names and each formulation was assigned a number to mask its identify before being passed on to EPA. The EPA used the actual formulations (in their masked format) as the basis for the evaluation of health and environmental concerns, though the data appearing in this document have been reported by chemical family to conceal

The health and environmental concerns associated with each blanket wash were evaluated based on the actual chemical formulations of each product.

proprietary formulation data. While specific methods were developed by the DfE Lithography Project team for conducting the performance demonstration and the cost analysis, the standard methodologies of the EPA Office of Pollution Prevention and Toxics (OPPT) Existing Chemicals Program were used for the Human Health Hazards, Environmental Hazards, Environmental Releases and Occupational Exposure Assessment, General Population Exposure Assessment, and Risk Assessment sections of the CTSA.

Identify Conservation and Additional Improvement Opportunities

The project partners were interested in identifying energy and natural resource issues and improvement opportunities associated with using the various substitute blanket washes. Although the blanket washing process is not particularly energy- or resource-intensive, a printer can still help conserve energy and resources through his or her choice of blanket washing products and the manner in which the products are used.

There are a variety of techniques which may be employed at lithographic print shops to prevent pollution, to reduce chemical consumption, and to minimize waste. Results of a pollution prevention survey which asked lithographers to identify what activities they currently employ to achieve a more environmentally friendly workplace are presented. In addition, options for recycling solvents and for extracting solvents from press wipes are addressed, as are methods for treating spent solvents so that they may be reused. Solvent recycling systems used in conjunction with brush-based automatic blanket wash systems are also discussed.

Evaluate Trade-Off Issues

The trade-off issues associated with the environmental and human health risk, cost, performance, and other analyses undertaken by the project partners are evaluated. This includes a social benefit and cost discussion and a summarization of the project's findings.

1.2 OVERVIEW OF LITHOGRAPHIC PRINTING

1.2.1 Products Printed

Lithography is currently the most prevalent printing technology in the United States. According to an estimate by A.F. Lewis & Co., Inc., a market research firm specializing in the graphic arts industry, there are over 53,000 establishments employing printing presses, and approximately 49,000 of these use lithographic presses. Lithographic printers are primarily small businesses, with roughly 85% of the plants employing fewer than 20 people. The success of lithographic printing is due to the ability of the process to produce high quality text and illustrations cheaply and effectively in short, medium, and high volume production runs. Consequently, lithography dominates the printing of books and newspapers, as well as magazines and other periodical publications. Some other applications of the lithographic printing process include advertising, envelopes, labels and tags, stationery, greeting cards, and packaging. Lithography accounts for almost 50% of the commercial printing market; however, the ascendancy of the lithographic process may soon be challenged by both improvements in flexography and relatively new plateless technologies which make up the fastest growing sector of the printing industry.

1.2.2 Printing Mechanism

The lithographic printing process involves a plate on which the image and non-image areas are on the same plane, as opposed to being either raised or indented. In this type of single plane, or planographic, printing, the image is maintained by taking advantage of the mutual repulsion of oil and water. Plates are treated so that the non-image area attracts water, while the image area

becomes receptive to oil (ink). Water applied to the hydrophilic (water-loving) portion of the plate confines the ink within the oleophilic (oil-loving) image area. The water is applied in the form of a fountain solution which consists primarily of water with chemical additives that lower the surface tension of the water and control the pH. Ink is applied to the plate cylinder from the ink fountain. The image is transferred from the plate to a rubber or plastic blanket cylinder, and subsequently transferred to the substrate in a process known as offset printing. Lithography is the only major printing sector to use offset printing rather than direct printing, a process in which the image is transferred from the plate to the print medium without the use of an intermediate cylinder.

1.2.3 Types of Lithography

The lithographic printing process is divided into three separate sub-processes: sheetfed offset, heatset web offset, and non-heatset web offset. Sheetfed offset is a basic offset lithographic process in which paper is fed into the machine in individual sheets and the ink dries in an oxidative polymerization process. Sheetfed presses, used primarily for short term printing runs of commercial products, constitute the large majority (92%) of plants with lithographic presses and are the focus of the DfE Lithography Project. The web offset processes are so named because of their use of rolls of paper which are continuously fed into the press. The web is cut into individual sheets in post-press operations. Only 11% of lithographers use the web offset process, and, despite the tendency of lithographic shops to be small, almost 60% of those plants which utilize web-fed presses employ over 20 people.

In heatset web offset printing, inks are dried using a recirculating hot air system. This type of printing is very useful for high-volume, high-speed production runs (up to 40,000 impressions per hour); however, the ink drying process involved may result in VOC emissions that must be controlled. In contrast, the non-heatset web offset process often uses inks that do not require assisted drying. This type of lithographic printing is commonly employed in high speed production of newspapers, magazines, and journals. Each of these sub-processes has some distinct environmental and human health impacts; however, the chemicals used to clean the presses are very similar regardless of which process is used.

1.2.4 Blanket Washing

For job changes and to maintain image quality in the offset printing process, the intermediate blanket cylinder must be cleaned. Blanket wash is used to remove ink, paper dust, and other debris from the blanket cylinder. If the blanket is not cleaned regularly, built up debris will damage the blanket and/or impact print quality adversely. The severity of ink and paper build up will vary depending on the product printed, the length of the printing run, the coverage of the image, and the colors printed. For color changes, the series of rollers that transfer the ink from the ink tray to the printing plate must also be cleaned. Some printers use the blanket wash product to clean the rollers, while others find that using two separate cleaners, a blanket wash and a roller wash, is more effective.

Blanket cleaning can be accomplished manually or automatically. Manual cleaning involves wiping down the blanket cylinder with a cloth wipe or a disposable wipe, dampened with blanket wash solution. Automatic blanket cleaners are mechanical devices that clear the blanket of debris by applying blanket wash and/or scrubbing the blanket mechanically. Excess wash is either wiped off automatically, or some systems simply allow paper to run through the press to absorb excess inks and solvents. The focus of the DfE Lithography Project effort is on evaluating manually applied blanket washes.

Blanket washes consist of varying types of solvent, some of which can pose risks to human health and the environment. New, potentially less harmful blanket washes are appearing on the market, giving printers the opportunity to reduce impacts on the environment and minimize risk to workers. As these alternatives to the traditional solvents become more widespread, printers have had more questions about where to find comparative risk, performance and cost information. The DfE Lithography Project addresses these concerns by providing this comparative information on a wide variety of blanket wash formulations.

1.3 PROFILE OF THE BLANKET WASH USE CLUSTER

1.3.1 Traditional Blanket Washes

Traditional lithographic blanket washes are petroleum-based solvents, often mixed with detergent and/or water. Petroleum-based cleaners typically remove ink quickly and evaporate rapidly, requiring minimal down time for the press. The advantages of these conventional cleaners, however, come at a price. Petroleum-based cleaners often contain greater than 60% VOCs. VOCs, defined as any volatile compound containing the element carbon, have health and safety concerns associated with their use, and have been implicated in the formation of ground level ozone. Still, conventional cleaners continue to dominate the market because of their effectiveness as well as their low cost.

The price of a petroleum-based blanket wash will vary according to the quantity purchased as well as the prevailing price of crude oil. At least two major U.S. manufacturers of blanket washes in the United States have product lines dominated by petroleum-based, water-miscible solvents. Prices for these blanket washes range from $8/gallon to $10/gallon and average $9/gallon when purchasing a 55-gallon drum. The market is very fractured, as the largest producers of blanket cleaner in the United States are estimated to control less than 10% of the total U.S. market. The market share attained by the largest blanket wash manufacturers is limited by competition from the many small blanket wash producers serving local markets.

Large printing operations will often benefit from bulk pricing, storing large quantities of wash in on-site storage tanks. Medium-sized printers tend to purchase blanket wash by the drum (55-gallons), while small operations typically pay the highest per unit costs by purchasing cases of single gallon containers. Per gallon prices can decrease by as much as 30% when purchasing a 55-gallon drum versus a single gallon container.

1.3.2 Alternative Blanket Washes

Petroleum-based blanket washes currently dominate the market; however, as concerns regarding the release of VOCs and potential health impacts mount, increasing pressure will be placed on blanket wash manufacturers to develop alternatives. Current evidence suggests that industry has responded to concerns regarding VOC releases, with some blanket wash manufacturers devoting 100% of product development time to the production of products that are lower in hazardous materials and VOCs.[1] Alternative blanket cleaners have not been fully accepted, however, and printers have voiced several concerns regarding their performance. In addition, low VOC washes typically cost more than "traditional," petroleum-based cleaners due to higher ingredient costs. EPA's *Control Techniques Guideline for Offset Lithographic Printing* (CTG) estimates that lower VOC cleaners (low VOCs cleaners are defined in the CTG as products with a VOC content of less than 30% by weight as measured by EPA's test method 24) that do not contain hazardous air pollutants (HAPs) cost $0.91 per pound versus $0.69 per pound for a "traditional" cleaner.[2] Alternative washes discussed below include: water miscible solvents, vegetable oil-based cleaners, and terpene-based cleaners.

Water Miscible Solvents

One approach to reducing VOCs in blanket washes has been to use water miscible solvents, thereby allowing a certain degree of water dilution. Reductions in VOC content are accomplished by substituting volatile solvents with water. It is important to note that not all water miscible cleaners contain less than 30% VOCs, however, many water miscible cleaners have a vapor pressure of less than 10 mm of mercury (Hg) at 20°C, which in some cases is considered to be as acceptable as a low VOC formulation.

Vegetable Oil-Based Blanket Washes

Some manufacturers are marketing vegetable oil-based cleaners that do not contain any petrochemical solvents, and that have VOC contents as low as five percent. While the list price for this type of cleaner can be significantly higher than for many of the petroleum-based cleaners on the market, printers calculating a cost-per-wash-up must consider that the product is sold in a highly concentrated form. The advantages of vegetable oil-based cleaners over "traditional" cleaners include: lower VOC levels, lack of odor, no special storage requirements, unprocessed wipes may be non-hazardous waste, and the blankets are conditioned by the cleaner. There may also be benefits to worker health and safety. Unlike highly volatile, petroleum-based cleaners, however, vegetable oil-based cleaners do not rapidly flash off from the blanket cylinder, and therefore a greater effort may be required to wipe off the blanket.

Terpene Cleaners

Terpenes are derived primarily from wood and citrus products and have long been used as solvents for a variety of organic compounds. The Montreal Protocol recommends the use of terpene solvents as an alternative to chlorinated solvents because they are not an upper atmosphere (stratospheric) ozone depleting substance and have zero global warming potential. Several terpene-based products are available on the market that provide an alternative to traditional, petroleum-based cleaners. According to an industry representative, terpene cleaners based on citrus tend to be very volatile in price; in 1995, the price per pound ranged from $1.26 to over $2.60. In addition, the odor of these solvents can be irritating or nauseating to press operators.[3]

Water-washable Ink System

Another type of vegetable oil-based blanket cleaning system has been developed recently which differs from the vegetable oil-based blanket washes described above in that the blanket wash is one part of an "ink system." The ink is vegetable oil-based and can be converted into a water-soluble form after printing is complete. Once the conversion has occurred, the water-soluble ink can be removed with a water-based blanket solution, thereby eliminating the need for traditional cleaning solvents containing VOCs. These ink systems are not available for all types of printing and have been utilized primarily in the business forms industry.

1.4 MARKET PROFILE

1.4.1 Blanket Wash Market

Currently, lithographic printing is the dominant printing technology in the United States, accounting for 79% of printing industry shipments.[4] According to Bruno's *Status of Printing*, lithography's share of the total U.S. market is expected to decline in the future. He estimates that lithography will control only 35% of the U.S. market by the year 2025, due to competition from flexography and plateless printing technologies.[5] Industry contacts indicated, however, that plateless printing will find its market "niche" and will not result in a market decline for the lithographic blanket wash industry.[6]

The lithographic blanket wash industry is extremely fragmented, made up of many small firms producing a host of blanket wash products, and is highly price competitive. In general, blanket wash manufacturers are chemical formulators that market a variety of pressroom products including type wash, press wash, alcohol replacers, and fountain solutions.

In response to concerns regarding the release of VOCs, blanket wash manufacturers have developed and are currently marketing low VOC alternatives to traditional, petroleum-based cleaners. For example, low VOC cleaners currently constitute a very small percentage of company sales for one of the leading producers of blanket cleaners in the United States. Their research efforts, however, are focused almost exclusively on the development of low VOC cleaners.[7] Small to medium size companies have had greater success in providing low VOC cleaners to the marketplace.[8,9]

A.F. Lewis & Company, Inc., a market research firm specializing in the graphics arts industry, has estimated the number of plants operating offset lithographic presses, and therefore the number of facilities requiring blanket wash solvents, to be 49,218 as of June 1995. A.F. Lewis also reports the total number of plants with presses (whether offset lithographic, gravure, flexographic, or letterpress) to be 53,205 plants as of June 1995.[a] Plants with offset lithographic presses, therefore, account for roughly 92% of printing facilities, providing some indication of the demand for blanket wash. The states with the greatest number of plants containing offset presses are: California (6,075 plants, 12.5% of the U.S. total), New York (3,617 plants, 7.4%), Illinois (3,027, 6.2%), Texas (2,947, 6.0%), Pennsylvania (2,452, 5.0%), Ohio (2,436, 5.0%), Florida (2,318, 4.8%), New Jersey (1,876, 3.9%), Michigan (1,691, 3.5%), and Massachusetts (1,388, 2.9%).[10]

1.4.2 Blanket Wash Manufacturers

Minimal documentation exists that specifically characterizes the lithographic blanket wash industry. The Standard Industrial Classification (SIC) system, established by the Bureau of the Census to track the flow of goods and services within the economy, has not assigned a specific code to the blanket wash industry, nor does the Department of Commerce specifically track the industry.[11] In addition, many companies that produce printing equipment also manufacture blanket washes or private label another manufacturer's wash, making it difficult to identify them specifically as blanket wash manufacturers. With multiple product lines for the industry, it is currently not possible to identify the portion of revenues attributable solely to blanket wash production.

The companies listed in Table 1-1 are known to be producers of blanket wash solvents or products based upon the input of several printing industry trade organizations. This list is not exhaustive of the total number of companies producing blanket washes. The relative market share held by each of the companies listed below is not known. Petroleum distillate producers, such as Ashland, Exxon, and Shell, also sell directly to larger printers.[12]

[a] *Plants with presses are firms that possess any printing press or duplicator/photocopier and engage in printing as their primary business.*

1.4.3 Blanket Wash Components

Blanket wash manufacturers combine a wide range of ingredients to produce their final product. Some of the leading ingredients of high VOC washes include: solvent 140, aromatic 100, aromatic 150, and naphthal spirits. Low VOC washes include ingredients such as fatty acid derivatives or terpenes. A survey of three blanket wash manufacturing companies, estimated to represent 70% of the blanket wash market, was conducted in 1992. Table 1-2 presents the estimated annual quantity of 24 chemicals used in the manufacture of blanket wash and roller wash. While not comprehensive, these volumes provide an idea of the size of the industry and the range of chemicals currently utilized in the production of blanket wash.

Table 1-1. Lithographic Blanket Wash Manufacturers*

Company	Location of Headquarters
AM Multigraphics*	Mount Prospect, IL
Anchor/Lithkemko*	Orange Park, FL
Ashland Chemical*	Columbus, OH
Bingham Company	Wood Dale, IL
BLI Manufacturing	Winston Salem, NC
Dupont Printing and Publishing*	Wilmington, DE
Electro Sprayer Systems, Inc.	Elk Grove Village, IL
Environmental Scientific, Inc.*	Research Triangle Park, NC
Environmental Solvents, Inc.*	Jacksonville, FL
Fine Organics Corporation*	Chicago, IL
Flint Ink	Detroit, MI
HMI Environmental Products*	Encinitas, CA
Hurst Graphics, Inc.*	Los Angeles, CA
Inland Technology Inc.*	Tacoma, WA
Litho Research Inc.	Chicago, IL
MacDermid, Inc.*	Waterbury, CT
Printex Products Corporation*	Rochester, NY
Prisco/Printers' Service, Inc.*	Newark, NJ
RBP Chemical Corporation*	Milwaukee, WI
Rycoline Products, Inc.*	Chicago, IL
Siebert, Inc.*	Lyons, IL
Tower Products Inc.*	Palmer, PA
Unichema Corporation*	Chicago, IL
Varn International	Oakland, NJ
Witco*	New York, NY

* Indicates those manufacturers that participated in this Project; this is not an exhaustive list of manufacturers.

Table 1-2. Blanket Wash and Roller Wash Components

Ranking	Chemical	CAS Number	Annual Quantity
1	Solvent Naphtha (petroleum), medium aliphatic*	64742-88-7	655,722
2	Solvent Naphtha (petroleum), light aromatic*	64742-95-6	633,000
3	Naphtha (petroleum), hydrotreated heavy*	64742-48-9	606,125
4	Solvent Naphtha (petroleum), light aliphatic*	64742-89-8	468,508
5	2-Butoxyethanol	111-76-2	288,000
6	Solvent Naphtha (petroleum), heavy aliphatic	64742-96-7	146,497
7	Mineral Spirits (straight run naphtha)*	64741-41-9	140,000
8	Methylene Chloride	75-9-2	125,003
9	Xylene*	1330-20-7	76,503
10	1,1,1-Trichloroethane	71-55-6	66,000
11	Isopropyl Alcohol	67-63-0	60,000
12	Acetone	67-64-1	55,000
13	Mineral Spirits (light hydrotreated)*	64742-47-8	51,943
14	Toluene	108-88-3	51,000
15	Solvent Naphtha (petroleum), heavy aromatic*	64742-94-5	49,815
16	Propylene Glycol Methyl Ether Acetate	108-65-6	38,000
17	2-Propoxyethanol	2807-30-9	27,932
18	d-Limonene*	5989-27-5	22,000
19	Dipropylene Glycol Methyl Ether*	3459-94-8	12,000
20	Kerosene	8008-20-6	10,000
21	Ethyl Acetate	141-78-6	2,000
22	Perchloroethylene	127-18-4	2,000
23	Diethylene Glycol Monobutyl Ether*	112-34-5	1,879

* Indicates those chemicals found in the formulations assessed in this project.
Note: Information is based upon a 1992 survey of three blanket wash producers and is estimated to represent 70% of the industry.

1.4.4 Market Conditions

Based on discussions with industry representatives, the lithographic blanket wash industry is characterized by thin profit margins and extreme price competition. Blanket wash manufacturers, seeking to maximize the efficiency of their operations, will often subcontract with off-site blending companies to combine the raw material inputs of their formulations in large mixing tanks. Blanket wash manufacturers with the largest market areas are most likely to blend off-site to avoid the transportation costs associated with hauling their product to distant markets. Because freight costs tend to consume profits, foreign competition of products produced outside the U.S. has been limited in the United States market.[13,14]

The Association for Suppliers of Printing and Publishing Technologies (NPES) tracks an estimated 90% of the total U.S. market for graphic art supplies; this information is reported in the NPES *Monthly Statistics Report and Quarterly Economic Forecast*. Shipments data include information on various papers, films, plates, chemicals, and other graphic arts supplies. The chemicals category includes three subcategories: photographic chemicals, plate chemicals, and press chemicals. Blanket cleaners are included within the press chemicals subcategory; however, financial data are not made available for the chemicals category in order to avoid disclosure of individual company figures. The report does indicate that 1994 chemical shipments are estimated to rise 2.2% compared to 1993 and are projected to increase 4% in 1995 and 1996.[15] No basis is available to estimate what percentage blanket washes may represent within the broader chemical category. Industry contacts, however, estimate that blanket wash sales generate $60-70 million annually in the United States.[16]

1.5 ALTERNATIVE TECHNOLOGY - AUTOMATIC BLANKET WASHERS

Technology Description

An alternative to washing blankets manually is to use automatic or mechanized blanket washers. Automatic blanket washing is a technology that uses a spray, brush, and/or cloth system to clean the rubber blankets with little or no human assistance while the press is running. Automatic blanket washers are becoming increasingly available as standard equipment on new web and sheet fed presses, and as a retrofit on older presses.

Although usually marketed as cost and labor saving devices, automatic blanket washers may also provide environmental benefits by reducing VOC solvent use and the need for wipe rags. Some systems also have solvent reclamation systems, and are designed to minimize fugitive emissions in the workplace. In addition, automatic blanket washers may mitigate some health and safety concerns for press operators because they reduce a press operator's contact with solvent, rags, and the moving press cylinders. It is important to note, however, that even presses equipped with automatic blanket washers still require occasional manual blanket washing, particularly for end-of-run applications.

Depending on the blanket washing system, all automatic washers use a certain amount of the paper running through the press to help remove ink from the blanket during the wash cycle. Three basic forms of automatic blanket wash systems are currently available including; spray systems, brush roller systems, and cloth-based systems. Each system is discussed below.

Spray application systems are available for web presses, and operate by applying cleaning solvent directly to the blanket. The web continues to feed through the press, carrying away excess ink and debris dissolved by the solvent. Spray systems typically involve a relatively small capital investment relative to other blanket wash systems.

Brush roller systems, unlike spray systems, actively scrub blanket surfaces with a rotating and oscillating brush. Two types of brush systems are available: dry-type and wet-type. Wet-type brush systems dispense a controlled quantity of solvent onto the brush. Solvent is not applied directly to the blanket. Dry-type brush systems mechanically clean the blanket surface but are not wetted with cleaning solution. Dry-type systems are used only on coldset presses.

Cloth-based systems operate by applying a web of cloth to the rotating blanket, depositing excess ink and debris onto the cloth. After completing the cycle, the spent cloth advances and a fresh section of cloth is left in its place. Cleaning solvents are applied to the cloth and not directly to the blanket.

Performance Issues

Reports on the performance of automatic blanket washers run the gamut from printers who say that their automatic washers work faster and better than manual washing, to those who have given up and actually removed the blanket washers from their presses. Clearly, the type of blanket washer and the type of printing being done play large roles in determining the effectiveness of the blanket washer.

Automatic blanket washers appear to be more prevalent on web presses, where they can be used for blanket washing during a press run. Some printers report that automatic blanket washers do not clean the blankets thoroughly enough to use them for end of run washing. Blanket washers seem to be less popular for sheet-fed presses, where relatively shorter run lengths allow printers to coordinate manual blanket washing with the end of production runs.

Economics

The potential ***savings*** associated with using an automatic blanket washer instead of manually cleaning blankets include the following:

- In most cases, wash for wash, automatic blanket washers reportedly use less solvent than manual washing, which translates into lower solvent costs for the printer.
- Because the automatic blanket washer allows the press operator to perform other tasks during the wash cycle, there may be significant labor savings associated with automatic blanket washing.
- Make-ready time is shortened because the press does not stop during the blanket washing process.
- Wipe rag use is reduced, which confers savings in the area of rag purchasing or in rag leasing contracts. For cloth based systems, disposal or laundering of the spent cloth may be a concern.
- Some printers claim that blanket life is prolonged through the use of automatic blanket washers.

The potential ***costs*** of automatic blanket washers include the following:

- The blanket washing system itself is a significant added cost, particularly when a retrofit is under consideration. On many new presses, however, automatic blanket washers are standard equipment.

- Maintenance costs may also be a factor. This would include routine maintenance as well as brush and other parts replacement.

Based on information collected from two of the major firms manufacturing automatic blanket wash systems, it appears that blanket washers are in widespread use on the larger, newly purchased presses. One or two unit presses, measuring less than 20 inches, are unlikely to be purchased with an automatic blanket washer. The cost of a brush roller system or cloth-based system ranges from $7,000 to $22,000 per unit, depending upon press size and the number of press units. These prices do not include the cost of installation, which varies according to the type of system required and location of the printing facility. Per unit costs decrease as the number of press units increases. A spray system, which involves the smallest capital investment, has been estimated to cost roughly half the price of a brush roller or cloth-based system, ranging from $3,500 to $11,000 per unit depending upon press size.[17,18] Currently, automatic blanket wash systems are typically not affordable for small presses (32" or less), although some manufacturers indicate they intend to market a cloth-based blanket wash system specifically designed for smaller presses, making it possible for small press operators to invest in automatic blanket cleaning technology.[19]

The retrofit market is more difficult to characterize and industry contacts could not provide a clear sense of how widespread the use of automatic blanket wash systems may be on existing presses. This said, the retrofit market does constitute a significant portion of automatic blanket wash system sales.[20,21] When considering a retrofit purchase, printers must weigh the benefits of increased productivity and worker safety against the significant capital investment required to purchase a cleaning system. In some cases, printers are operating older, outdated presses that do not justify the significant capital investment required to purchase an automatic blanket cleaner. The price of a retrofit blanket wash system is the same as that of a system purchased with a new press. In either case the procedure would be the same, that is the manufacturer of the blanket wash system would install the unit at the printing facility.[22,23]

Environmental Impacts

Environmental benefits and costs associated with automatic blanket washers may include:

- On a per wash basis, automatic blanket washing conserves solvent as compared to manual blanket washing. Because automatic blanket washing is more convenient than manual washing, however, press operators may clean blankets more frequently. Currently, there are insufficient data to assess whether total solvent use increases or decreases in practice.

- VOC-soaked rag waste is reduced. For cloth based systems, disposal or laundering of the spent cloth may be a concern.

- Because a large amount of paper is wasted in manual blanket washing due to press start up and shut down, automatic blanket washing may conserve paper.

- Low VOC solvents may be used with some systems.

Health/Safety Issues

Worker safety issues associated with automatic blanket washers may include:

- Direct worker dermal exposure to solvent is reduced.
- With some systems, much of the solvent can be reclaimed for re-use.
- Diminished fugitive VOC emissions in the workplace.
- Workers can lessen exposure to potentially dangerous moving press cylinders associated with manual blanket cleaning.

Automatic Blanket Wash System Manufacturers

Manufacturers of automatic blanket washers include: AM Multigraphics; Baldwin Technology; Oxy-Dry Corporation; Printex Products Corporation; Heidelberg Harris, Inc.; and Web Printing Controls Company Inc. This list was compiled based upon discussions with industry contacts as well as the NPES *Directory of International Suppliers of Printing & Publishing Technologies*. This list is not exhaustive.

References

1. Cross, Lisa. "Suppliers Expand their Eco-roles." *Graphic Arts Monthly*. December 1994.

2. U.S. EPA. *Control Techniques Guideline for Offset Lithographic Printing - Draft*. July 12, 1993.

3. Hoppe, Debbie. Printex Products Corporation. "Comments on the Draft CTSA Review," memorandum to Jed Meline, U.S. EPA. April 19, 1996.

4. U.S. Department of Commerce. U.S. Industrial Outlook 1994. January 1994.

5. Bruno, Michael H. *Michael H. Bruno's Status of Printing, 1991 Update: A State-of-the-Art Report*. Salem, NH: GAMA Communications, 1991.

6. Kannenberg, Mark. RBP Chemical Corporation. Fax received April 19, 1995.

7. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Ray Brady, Anchor/Lithkemko, Orange Park, FL. May 3, 1995.

8. Jadrich, Paul. Siebert, Inc., comments on draft submitted to Jed Meline, U.S. EPA on Nov 7, 1995.

9. Crawford, James. State of Wisconsin Department of Natural Resources comments on draft to Jed Meline, U.S. EPA. Nov 1995.

10. Lewis, A.F., Blue Book Marketing Information Reports. June 1994.

11. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Bill Lofquist, Department of Commerce, Washington, DC. May 3, 1995.

12. Jadrich, Paul. Siebert, Inc. Comments on draft provided to Jed Meline, U.S. EPA. Nov 7, 1995.

13. Sheppard, William J. Litho Research. Fax received April 21, 1995.

14. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Ray Brady, Anchor/Lithkemko, Orange Park, FL. May 3, 1995.

15. NPES. The Association for Suppliers of Printing and Publishing Technologies, *Monthly Statistics Report and Quarterly Economic Forecast*. 1994.

16. Kannenberg, Mark. RBP Chemical Corporation. Fax received April 19, 1995.

17. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with C.K. Berthold, Oxy-Dry Corporation, Itasca, IL. April 20, 1995.

18. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Jerry Hubbard, Baldwin Graphic Systems, Stamford, CT. April 27, 1995.

19. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Jerry Hubbard, Baldwin Graphic Systems, Stamford, CT. April 27, 1995.

20. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Jerry Hubbard, Baldwin Graphic Systems, Stamford, CT. April 27, 1995.

21. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with C.K. Berthold, Oxy-Dry Corporation, Itasca, IL. April 20, 1995.

22. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with C.K. Berthold, Oxy-Dry Corporation, Itasca, IL. April 20, 1995.

23. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Jerry Hubbard, Baldwin Graphic Systems, Stamford, CT. April 27, 1995.